

RESEARCH ARTICLE

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EFFICIENCY AND SELECTIVITY OF GILLNET MESH SIZES FOR ASSESSING FISH COMPOSITION OF EGBE WATER RESERVOIR, EKITI STATE, NIGERIA

*ADEBOLA, Oluwatoyin Tolulope, SABEJEJE, Timothy Abiodun and OSUNGBEMIRO, Nelson Rotimi

Department of Biology, Adeyemi College of Education, Ondo

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ABSTRACT

Comparism of five (5) different gillnet mesh sizes ranging from 50.8mm, 63.5mm, 78.2mm, 88.9mm, and 101.6mm was done at four (4) different sampling stations along the banks of the reservoir to evaluate the efficiency and selectivity of gillnet mesh sizes for assessing fish composition in Egbe water reservoir, between April, 2014 and January, 2016. The nets were set at 6.00pm and hauling done in the morning at 8.00am, fishermen were well monitored to avoid sampling bias and ensure a constant fishing effort. The fishes were sorted into separate container based on gillnet mesh sizes and also species. The total length and weight of individual were taken, Simpson's index, Simpson reciprocal index and Evenness were also determined. The percentage composition by biomass fish landing was recorded. 31,905 fishes belonging to 7 species and 5 families were recorded. The most abundant family was the Cichlids represented by 3 major species, *Oreochromis niloticus*, (25.41%), *Coptodon zillii* (17.59%), and *Tilapia guineensis* (15.74%) while *Clarias gariepinus* (15.07%) belong to the Clariidae. Also, *Parachanna obscura* (13.45%), *Hepsetus odoe* (7.08%) and *Heterotis niloticus* (5.67%) belong to the family Channidae, Hepsetidae and Osteoglossidae respectively. Simpson's index of diversity 0.46, Shannon – weiner (H) (1.98), Evenness (E) (1.61) and Margalef's index (0.94). All the five gill nets captured all the fish species but the smallest gill net mesh size (50.8mm) (43%) captured more of *O.niloticus* and greater number than others, this shows that the smaller gill mesh nets were more efficient for capturing more fishes than other graded mesh nets, but should be discouraged for artisanal fishing activities in the study area, other gears like hook and line, cast nets and traps should be encouraged.

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INTRODUCTION

Gillnet is a passive one – walled gear whose mode of catch is by gilling /wedging in a single individual mesh at the maxillae, the operculum and the point of maximum girth (Oginni, 2010). Gill net is a large wall of netting vertically hanging in the water. The net may have just one sheet of twine in which the fish are trapped by their gills when they try to swim through or many sheets of various mesh sizes of which they are entangled (Emmanuel et al, 2008). Gillnet is very popular among artisanal fishermen in Nigeria. Fish catchability and size selection by gillnets are influenced by factors which are related either to the characteristics of the net or the fish. The probability of fish being captured depends on it encountering the net and its ability to avoid it, which is mainly a function of its swimming capability and length (Emmanuel et al, 2010).

*Corresponding author: ADEBOLA, Oluwatoyin Tolulope
Department of Biology, Adeyemi College of Education, Ondo

In fresh water (inland water), gill nets are operated either as stationary bottom set or floating form strung between stakes or anchored. It is by far the most important because of its versatility, low cost and ease of operation. The use of gillnet has its own drawbacks; fish caught when operated overnight are almost rotten or are attacked by other species by the following morning when its being hauled. Fish already caught may frighten away later arrivals, or escape and there is also a net saturation effect which means that the catch per unit time does not increase proportionately to the time of setting. Little work has been done on the abundance, distribution of fish species and physico – chemical parameter of Egbe Reservoir (Edward et al, 2013) but not withstanding, a good knowledge of the efficiency and selectivity of gillnet as one of the fishing gear used by fishermen on the reservoir and the effects of technical innovations by the fishermen on the efficiency of gillnets are important for the reconstruction of the population in fish stock assessment and should be quantified for proper

fisheries management and ecology (Machiels *et al.*, 1994, Oginni, 2004, Emmanuel *et al.*, 2008). There is therefore need to study the effectiveness of gill net and their selectivity, this study therefore investigates the efficiency and selectivity of gill net mesh sizes for assessing fish composition in Egbe reservoir.

MATERIALS AND METHODS

Study Area: Egbe reservoir is situated across Egbe Ekiti located in the suburb of Egbe in Gbonyin Local Government Area of Ekiti State, Nigeria. The reservoir lies between latitude 7°36' North to 7°39' North and longitude 5°32' East to 5°36' East of the equator. Egbe reservoir originates from Kwara State and flows North to South through Ode to Egbe Ekiti. It was built in 1975 by damming the Ose river at Egbe Ekiti. It covers an area of 26.5ha with a depth of 56.4m at its deepest. The capacity of the reservoir is about 14.4million m³. The river bed rock is comprised of metamorphic rock and it is surrounded on each side by a stretch of thick forest. It serves as source of drinking water, domestic needs, swimming, artisanal fishing and irrigation of agricultural farms in its vicinity.

catch the same time. Fish were sorted into mesh sizes and stratum and kept in separate containers for identification and weighing. The fish specimens were sorted out, counted and identified to species level by means of keys prepared by Adesulu and Sydenham (2007). The total length was taken from the tip of the snout to the tip of the caudal fin, while the standard length was taken from the tip of the snout to the base of the caudal fin. The total length was measured with a meter rule and a measuring board to the nearest 0.1cm while the weight was measured to the nearest 0.1kg using a digital weighing scale model CT6000 (Ohaus) after mopping the fish with filter paper.

Statistical analysis

Means, percentages, standard deviations were used to analyse the total number of species per season and compared using one way analysis of variance (ANOVA). Fish diversity indices were analysed using Margalef's index (d) of taxa (species) richness, Simpson's index (1), the Shannon Weiner (H) index for general diversity and Evenness index (E) to express the abundance and distribution of fish species.

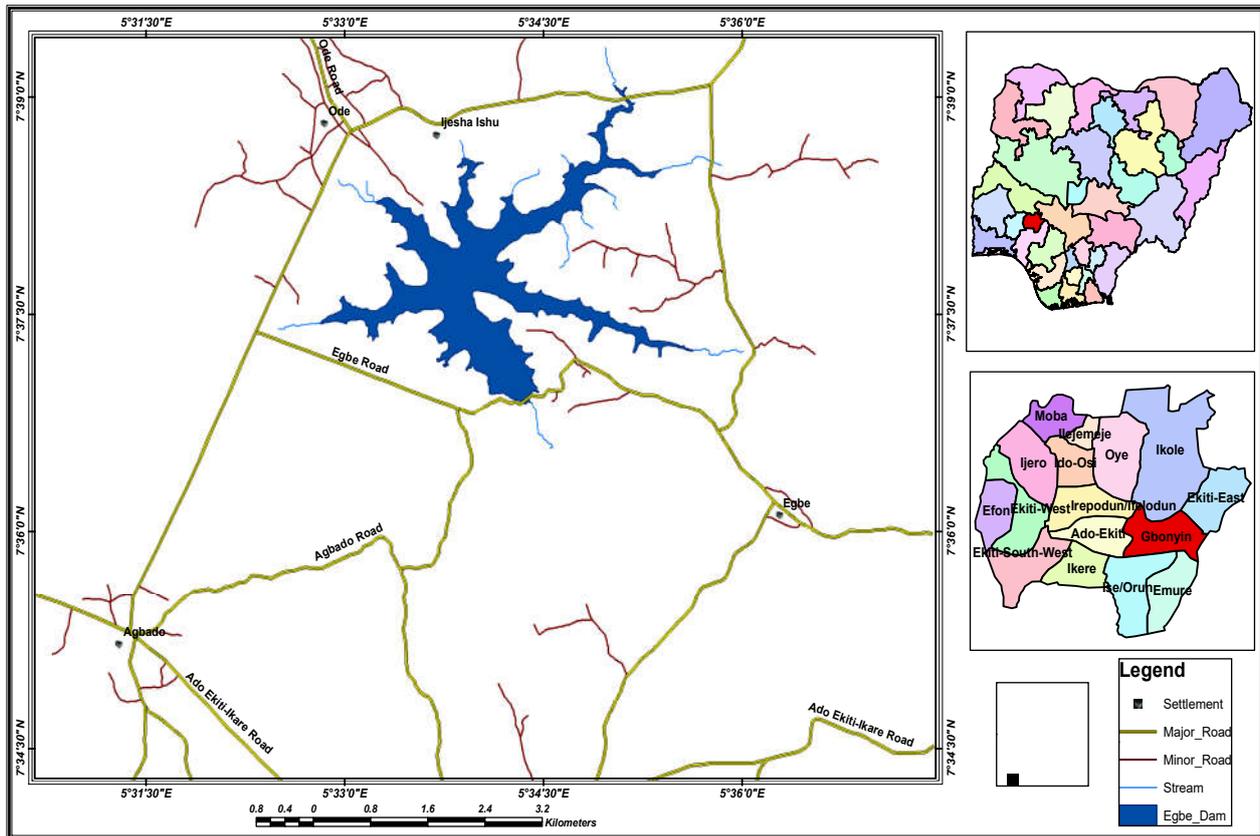


Fig. 1. showing the samples locations at Egbe Reservoir, Ekiti State, Nigeria

Fish sampling in the Egbe reservoir: The research study on the assessment, composition and distribution for Egbe reservoir, the sampling was conducted between the months of April 2014 to January 2016 to represent two hydrological cycles of wet and dry seasons. The months were later separated into dry season (Oct - March) and wet season (April - Sept) with the assistance of hired local fisher folks. Sampling bias was prevented by monitoring to ensure that fisher folks set all the gill net mesh sizes 50.8mm; 63.5mm; 76.2mm; 88.9mm; 101.6mm to collect samples a month. Nets were set overnight and hauling done the following morning to remove

Margalef's Index (d) = $S - 1 / \ln(N)$

where S=total number of species (which depends on the sample size).

N= total number of individuals and

ln =natural logarithm.

The higher the size, the higher the species richness.

Shannon Index (H') is the most widely used measure of diversity (Ogbeibu *et al.*, 2005)

$$HI = \sum P_i \ln P_i$$

where P_i is the proportion of individual found in the i th species

$I = i/N$ 'N' is the total abundance.

$$\text{Evenness Index (e)} = H / H_{\text{MAX}}$$

Where H' = Shannon –Weiner diversity

Catch per unit effort was calculated by dividing the total monthly catch by the effort (number of each type gillnets) divided by the number of hours of fishing (Kings, 1991)

RESULTS

Fish Fauna: The fish biology and catch assessment survey were done simultaneously in the sampling locations using the gill net of various mesh sizes. Each fisherman catch or harvest was enumerated down to the species level. The species composition during the study period is presented below. In the reservoir, a total number of seven (7) species belonging to five (5) families were obtained. *O.niloticus*(25.41%), *C.zillii* (17.59%), and *T.guineensis*(15.74%) belong to the family Cichlidae while *C.gariepinus* (15.07%) belong to the Clariidae. Also, *P. obscura*(13.45%), *H. odoe* (7.08%) and *H. niloticus* (5.67%) belong to the family Channidae, Hepsetidae and Osteoglossidae respectively. The family Cichlidae was most consistently followed by the family Clariidae which contributed (15.07%) by percentage and then the Channidae which was represented by *P.obscura* (sub adult size only).

The highest number of fish were collected in July and August at the Reservoir, the least number of total fish collection was in the month of October at Egbe Reservoir. The analysis of variance result for the total fish population during the study period showed that there is a significant difference across the months in the total catch. The analysis of variance result for the total fish population during the study periods showed that there is a significant difference across the months in the total catch. The two major families encountered at the reservoir are Cichlidae and Clariidae. Table 2 depicts the composition of caught fish by different mesh sizes at Egbe reservoir, all the nets mesh sizes (50.8mm, 63.5mm, 76.2mm, 88.9mm, and 101.6mm) in different quantities.

The differences in relative quantities of each type of fish caught by each mesh size of the gill nets could be attributed to the selectivity of the gill net. Comparison of the results of the quantities of fish caught by each of the nets mesh sizes shows that the highest by number and biomass was recorded in the net 50.8mm (1066.51) which is 43% of the total population, this might be due to the mesh size of the net which has the ability of catching only those species of fish that had grown up. The effectiveness of the gear to select a particular species had been found to be a product of two probabilities: (1) that of encountering of the gear by fish (2) that of retaining of caught fish by the gear. Gill net mesh sizes 50.8mm followed by 62.5mm caught more fish species, this finding indicated that fish community in the reservoir is dominated by small fishes during the period of the research. Although, gill net was considered as selective fishing gears, it seems to be a size selective rather than species selective as reported by Sikoki *et al*, 1998.

Table 1. Relative abundance of the fishes at Egbe Reservoir during Dry and Wet seasons from April 2014-January 2016

Species	Dry	Abundance %	Wet	Abundance %	Annual	% Abundance
<i>Oreochromis niloticus</i>	2938	15.09	5169	27.10	8107	25.41
<i>Coptodon zillii</i>	1477	11.50	4136	21.69	5613	17.59
<i>Tilapia guineensis</i>	1709	13.31	3312	17.36	5021	15.74
<i>Clarias gariepinus</i>	2868	22.34	1941	10.17	4809	15.07
<i>Parachanna obscura</i>	2276	17.73	2014	10.56	4290	13.45
<i>Hepsetus odoe</i>	838	6.52	1422	7.45	2260	7.08
<i>Heterotis niloticus</i>	730	6.91	1075	5.64	1805	5.67
	12836	40.23	19069	59.76		

Table 2. Total catch of fish species caught with various gill net mesh sizes at Egbe reservoir

Mesh Sizes (mm)	<i>O.niloticus</i>	<i>C.zillii</i>	<i>T.guineensis</i>	<i>C.gariepinus</i>	<i>P.obscura</i>	<i>H.odoe</i>	<i>H.niloticus</i>	Total
50.8	655.17	300.51	50.57	50.01	8.00	1.38	0.87	1066.51(43.0%)
63.5	318.01	215.20	101.43	10.67	3.24	6.4	3.18	658.13(26.57%)
76.2	172.56	113.65	135.96	21.58	3.79	4.72	8.54	460.80(18.60%)
88.9	105.00	18.73	39.53	15.42	5.63	3.48	0.10	187.89 (7.58%)
101.6	38.63	21.56	36.06	1.54	3.89	1.6	1.24	104.52(4.21%)
Total	1289.37	669.65	363.55	99.21	24.55	17.58	13.83	2477.74

Table 3. Diversity Indices of Each fish family (From April 2014-January, 2016)

Fish family	Shannon-weiner index	Evenness	Margalef index	Simpson's index of diversity
Cichlidae	0.8675	1.0854	0.6544	3.6320
Clariidae	0.0633	0.0871	0.5720	1.7433
Channidae	0.0437	0.028	0.2746	1.3562
Hepsetidae	0.0120	0.06	0.0034	0.0251
Osteoglossidae	0.0051	0.004	0.0021	0.6340

The data were separated into wet season (April –September) and dry season (October- March) for fish specimens by monthly catch, it showed that the greater number of individuals were caught during wet season (19069) (59.76%) than the dry season (12836)(40.23%). The wet season catch was thus significantly different from the dry season catch.

This could be attributed to the fact that gill net is a passive gear, fish has to encounter the net, enter and get retained. More active fish species are more likely to encounter the net. The diversity indices of the fish family was calculated and for the reservoir as a whole. The results indicated low species

diversity (Table 3 and 4). The evenness based on 1 -D values are 1.0854, 0.0871, 0.028, 0.06, and 0.004.

Table 4. Diversity Indices of Egbe Reservoir

Diversity index	Egbe
Number of species (Species richness)	7
Number of individuals	31905
Simpson's index (D) = $-\sum(n-1)/N(N-1)$	0.4682
Shannon-weiner index (H) = $-\sum p_i \ln p_i$	1.9862
Evenness (E) = eH/S	1.6126
Margalef index (D mn) = $S^{-1}/\ln N$	0.9424

DISCUSSION

Ichthyofauna of the reservoir are generally low with five (5) species from two (2) families i.e. the family Cichlidae and Clariidae. The species richness of each of the stations studied in Egbe reservoir compares favourably with those of Tiga reservoir (Bankole, 1991) and Tatabu flood plain (Daddy *et al*, 1991). In the reservoir, there were more Cichlids than fishes from other families Dan- kishiya *et al* (2013) in lower Usuma reservoir in Buhari, Abuja, Nigeria; Edward and Ugwumba (2013) had similar report from Egbe reservoir Ekiti State, Nigeria and Komolafe *et al* (2014) in Osinmo reservoir, Ejigbo, Nigeria where the cichlids constituted the highest catch fish. Their abundance is attributed to their adaptation to lentic aquatic environmental qualities, productivity of the reservoir and changes in hydrological regime of the reservoir (Idowu *et al*, 2004, Edward *et al*, 2013). They must have abundant food to thrive upon as the tendencies for most Cichlids to breed early during the floods at the margin of the advancing water. The vast vegetation that is found along the fringe of the lake in the present study affords those species a good breeding and nursery ground as well as cover from predators as reported by Edward (2013). Clariidae that were encountered at the reservoir at the stations was *Clarias gariepinus*, they were mostly juveniles. The other fish species caught at Egbe reservoir were *H.odoe*, *P.obscura*, and *H.niloticus* which were highly valued has been greatly reduced and has been replaced by less valued *O.niloticus*. The differences in relative quantities of each type of fish caught by each mesh size of the gill nets could be attributed to the selectivity of the gill net due to differences in mesh sizes at reservoir.

Comparison of the results of the quantities of fish caught by each of the nets mesh sizes show that the highest by number and biomass was recorded in the net 50.8mm, this might be due to the mesh size of the net which has the ability of catching only those species of fish that had grown up to it mesh size which were more compare to other fish sizes. The effectiveness of the gear to select a particular species had been found to be a product of two probabilities: (1) that of encountering of the gear by fish (2) that of retaining of caught fish by the gear. Gill net mesh sizes 50.8mm followed by 62.5mm caught more fish species and fishes at the reservoir (Oginni, 2004), this findings indicated that fish community in the reservoirs are dominated by small fishes during the period of the research. Although, gill net was considered as selective fishing gears, it seems to be a size selective rather than species selective (Sikoki *et al*, 1998). This could be attributed to the fact that gill net is a passive gear, fish has to encounter the net, enter and get retained. More active fish species are more likely to encounter the net. The fish enters the net, it depends on its size, body shape and mesh sizes.

Conclusion

The family Cichlidae was the dominant in Egbe reservoir. This goes to confirm that under uncontrolled conditions in most inland water, the Cichlids always dominate and this could be attributed to the high prolific breeding nature of members of the family *O. niloticus* was the dominant species in the reservoir. This could be attributed to good parental care of the family. The majority of the fish encountered were juveniles and sub adult which reduces the weight of the catch especially in Egbe reservoir where larger individual of *P. obscura*, *H. odoe* and *H. niloticus* were encountered. The presence of few individuals of *H.odoe* and *H. niloticus* indicates that these species requires adequate protection in the reservoir. The number of individuals and their biomass caught in wet seasons were higher than dry seasons. Generally, there is decline in abundance of medium and large fish species due to high fishing effort. Also, gill net been the main fishing gear used in the area accounted for 70.34% in Egbe reservoirs respectively. The total catch decreased with increasing mesh sizes and the 50.8mm mesh sizes (which had juveniles and sub adult fishes) was the most productive.. The fisheries of this reservoir can be considered overfished which has brought changes in species compositions this have direct implications on the fisheries. Thus, gill net mesh size regulation is recommended.

Recommendation

In view, of the fact that the reservoirs are overexploited with the small gillnet mesh sizes being utilized at the reservoir, the fishermen should be encouraged to embrace the use of other gears like the hook and line, cast net and traps for their fishing activities for increased fishing period and enhanced income. Finally, some interventions which include regular monitoring, stocking with new species, management of habitat to prevent sedimentation, clearing of vegetative cover, regulation of water levels and fishing regimes through legislation and education of all the stakeholders should be considered to improve the fish yield of Egbe reservoir to ensure sustainable management. The study has looked into catch assessment as a step towards proposing management option for fishery. However, given the complex nature of fisheries management, it may be necessary to look into other parameters (age at capture, exploitation rate etc).

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